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BIOLOGICAL SURVEYS OF THE UPPER JAMES RIVER BASIN. COVINGTON, CLIFTON FORGE, BIG ISLAND, LYNCHBURG, AND PINEY RIVER AREAS

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I. INTRODUCTION

A water quality pollution control study of the James River Basin conducted by the Chesapeake Bay-Susquehanna River Basins Project in 1966-67 included an evaluation of pollution control action needed to enhance and protect water quality in the Basin. To supplement chemical and biochemical water quality data used in the evaluations, the Chesapeake Field Station conducted biological surveys of the Jackson River in the Covington and Clifton Forge areas, the James River in the Big Island and Lynchburg areas, and areas in the Tye River Watershed affected by acid wastes.

For the purpose of the surveys, the community of bottom (benthic) organisms was selected as the indicator of the biological condition of the stream. Bottom organisms serve as the preferred food source for the higher aquatic forms and exhibit similar reactions to adverse stream conditions. The combination of limited locomotion and life cycles of one year or more, for most benthic species, provide a long term picture of the water quality of a stream. Fish and algal populations were given some consideration, but only to the extent that obvious conclusions could be drawn based upon casual observations.

In unpolluted streams, a wide variety of sensitive clean-water associated bottom organisms are normally found. Typical groups are stoneflies, mayflies, and caddisflies. These sensitive organisms usually are not individually abundant because of natural predation and competition for food and space; however, the total count or number of organisms at a given station may be high because of the number of different varieties present.

Sensitive genera tend to be eliminated by adverse environmental conditions (e.g., chemical and/or physical) resulting from wastes reaching the stream. In waters enriched with organic wastes, comparatively fewer kinds (genera) are normally found, but great numbers of these genera may be present. Organic pollution tolerant forms such as sludgeworms, rattailed maggots, certain species of bloodworms (red midges), certain leeches, and some species of air breathing snails may multiply and become abundant because of a favorable habitat and food supply. These organic pollution-tolerant bottom organisms may also exist in the natural environment but are generally found in small numbers. The abundance of these forms, in streams heavily polluted with organics, is due to their physiological and morphological abilities to survive environmental conditions more adverse than conditions that may be tolerated by other organisms. Under conditions where inert silts or organic sludges blanket the stream bottom, the natural home of bottom organisms is destroyed, causing a reduction in the number of kinds of organisms present.

In addition to sensitive and pollution-tolerant forms, some bottom organisms may be termed intermediates, in that they are capable of living in fairly heavily polluted areas as well as in clean-water situations. These organisms occurring in limited numbers, therefore, cannot serve as effective indicators of water quality.

Streams grossly polluted with toxic wastes such as mine drainage will support little, if any, biological life and will reduce the population of both sensitive and pollution-tolerant organisms.

Classification of organisms in this report is considered in three categories (clean-water associated, intermediate, and pollution-tolerant) which provide sufficient biological information to supplement physical and chemical water quality data for the study area. Tentative identification and counts of specific organisms have been tabulated for use during intensive investigations of selected areas and are available upon request.

II. SUMMARY AND CONCLUSIONS

1. Three biological surveys were made in the Upper James River Basin in conjunction with a water quality and pollution control study of the entire Basin.

Samples were taken July 13 - 14, 1966, at eight biological sampling stations located on the Jackson River between Clearwater Park and Iron Gate, Virginia, and at one station on the Cowpasture River.

The James River was sampled September 7 - 8, 1966, at 13 stations located between Maury River and Bent Creek.

The Piney, Tye and Buffalo Rivers were sampled in August 1967.

2. Bottom organisms were selected as the primary indicators of biological water quality.

3. Results of the Jackson River survey indicated exceptionally high water quality between Clearwater Park and the Covington Water Filtration Plant.

Biological samplings indicated that degraded conditions exist downstream from the West Virginia Pulp and Paper Company plant at Covington to Iron Gate, Virginia. The absence of clean-water organisms and the presence of pollution-tolerant forms, coloration, foaming, and slime-coated rocks were all indicative of poor water quality.

4. The Cowpasture River contributes water of high quality to the Jackson River.

Based on known biological sampling*, the River has recovered by the time it reaches Salisbury, Virginia, which is a short distance downstream from Eagle Rock, Virginia.

5. James River survey results indicated mild degradation downstream from Big Island with recovery conditions existing from the low level dam at Coleman Falls to Holcomb Rock which is upstream from Lynchburg, Virginia.

6. Downstream from Lynchburg the water quality becomes increasingly more degraded to Six Mile where severely polluted conditions exist. Heavy sludge deposits, sludgeworms, turbid water, and clumps of dead algae were all indicative of poor water quality in this reach.

7. The River begins to recover at Galts Mill but mild pollution was still indicated. Recovery conditions proceed over the next nine miles with good water quality finally indicated at Riverville, Virginia.

8. Upstream from Piney River the Tye River was found to possess high water quality based on the bottom organisms. Downstream from the confluence with the Piney River to its mouth at Norwood, Virginia, the Tye River is apparently degraded by the operation of the American Cyanamid Company on the Piney River at the Town of Piney River, Virginia.

9. Severely degraded biological conditions exist in the Piney and Tye Rivers, and the Tye River contributes poor quality water to the James River.

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* Biological data, Virginia State Water Control Board.

III. DATA EVALUATION AND INTERPRETATION

A. General

The Jackson River, which joins the Cowpasture River downstream from Iron Gate, Virginia, to form the James River, was sampled between Clearwater Park (upstream from Covington, Virginia) and Iron Gate in order to evaluate the biological conditions of the stream.

The James River was sampled between the Maury River and Bent Creek, Virginia. Two paper operations and the industrial community of Lynchburg, Virginia, are located in this reach. The mean flow at Bent Creek is 4,144 cfs.

Streams in the Tye River Watershed were sampled in areas upstream and downstream from the American Cyanamid Company's waste discharge location.

Sampling stations were located after consideration of the following conditions:

1. Tributaries
2. Areas having a known waste problem
3. Physical capability for sampling

Bottom organisms are animals that live directly in association with the bottom of a waterway. They may crawl on, burrow in, or attach themselves to the bottom. Macroorganisms are usually defined as those organisms that will be retained by a No. 30 sieve. In essence, the organisms retained by the sieve are those that are visible to the unaided eye.

Each station was sampled once, and the kinds of macro bottom organisms were observed for the purpose of evaluating water quality.

Quantitative bottom samples were also taken, using a Surber Square Foot Sampler or a Petersen Dredge (0.6 square foot), and the number of organisms per square foot were counted or calculated.

Quantitative samples were not taken at some stations because physical sampling conditions were poor or organisms were very sparse.

B. Biological Samples

1. Jackson River

Station #1 - Jackson River at the riffle immediately upstream from the Virginia Route 687 Bridge at Clearwater, Virginia.

The water at this station was clear and numerous smallmouth bass were observed throughout the area. High water quality was indicated by the 48 kinds (genera) of bottom organisms. They included such clean-water forms as stoneflies (3 genera), mayflies (4 genera), caddisflies (11 genera), fishfly, hellgrammites, two kinds of riffle beetles, and three kinds of gill-breathing snails. A total of 288 bottom organisms were collected in the square foot sample which included 86 mayflies, 24 caddisflies, three stoneflies, 83 gill-breathing snails, ten riffle beetles, and one fishfly. The clean-water organisms made up 78 per cent of the quantitative sample. Based on the bottom organisms, excellent water quality was indicated at this station.

Station #2 - Jackson River at the riffle approximately 100 yards upstream from the Covington, Virginia, Water Filtration Plant.

Numerous smallmouth bass and darters were observed in the clear water at this station. A small group of children was seen swimming downstream from the water filtration plant. High water

quality was again indicated by the 38 kinds (genera) of bottom organisms which included such clean-water forms as mayflies (8 genera), caddisflies (8 genera), stoneflies (1 genera), riffle beetles (2 genera), and hellgrammites. A total of 426 bottom organisms were collected in the square foot sample which included 95 mayflies, 51 caddisflies, and 94 riffle beetle larvae. Clean-water organisms made up 56 per cent of the total in the quantitative sample. High diversification and numerous clean-water forms indicated excellent water quality.

Station #3 - Jackson River at the Covington, Virginia Playground Park.

This station was located approximately 0.7 miles downstream from the pulp and paper company and adjacent to the Covington Municipal Playground. Virtually all of the rocks were coated with a heavy black slime believed to be Sphaerotilus sp. The water was a dark coffee color.

The water temperature was elevated and foam was observed. In addition, a strong odor characteristic of a mill operation was noted. The air-breathing snail Physa was present in fair numbers, but these snails were all at the waterline and on the rocks. For this reason a quantitative sample was not taken. Only a few sludgeworms and another bristleworm (Nais sp.) were found in addition to the Physa snails. Severe biological degradation is indicated at this station when compared with the upstream station. The enormous drop in genera from 38 (upstream station) to three at this station plus the complete absence of clean-water forms, indicated heavy industrial pollution.

All three kinds (genera) of bottom organisms found at this station were pollution-tolerant forms. The low dissolved oxygen and high water temperatures found by VMI sampling during this period further substantiate the poor biological conditions.

Station #4 - Jackson River at the riffle immediately downstream from the Durant Road Bridge due south of Covington, Virginia.

The coffee color, foaming, and elevated temperature noted upstream persisted at this station. The black slime coated the rocks and the strong odor also prevailed. The only bottom organisms present in fair numbers were the air-breathing Physa snails which were exposed at the water-line and on the rocks. The only other bottom organism found was the bristleworm Nais sp. Degraded biological conditions are still indicated by the presence of these two pollution-tolerant forms and the absence of clean-water bottom organisms.

Station #5 - Jackson River at the Drive-In Theatre east of Covington on Routes 60 and 220.

The water remained coffee colored, the foam persisted and rocks were still covered with the slime-like growth (already identified). The only bottom organisms found were pollution-tolerant sludgeworms, the air-breathing snail Physa, and an intermediate midge larva. The quantitative samples consisted of 488 sludgeworms. Heavy biological degradation was still indicated.

Station #6 - Jackson River off U. S. 60 and 220, approximately 0.5 miles upstream from the Low-Moor, Virginia, intersection.

The coffee color and foaming prevailed at this station also. Most of the rocks were still black and covered with the grayish-black slime. There were good populations of the air-breathing snail Physa in certain sections of the stream, but their distribution was erratic. A quantitative sample was not taken because of the spotty distribution of bottom organisms. Also collected were such pollution-tolerant forms as leeches, horsefly larvae, and another air-breathing snail. In addition, a beetle larva was also sampled. Degraded biological conditions were still indicated. This conclusion was supported by the low dissolved oxygen readings found in the VMI survey.

Station #7 - Jackson River at the mouth of Smith's Creek in Clifton Forge, Virginia.

The water continued to appear coffee color and foaming was present. Smith's Creek was very cloudy and appeared to be contributing a pollutional load from Clifton Forge. The rocks in the area were still black and coated with slime. Approximately 50 dead fish were observed in the area and appeared to be mostly suckers and minnows. Bottom organisms could not be found. Degraded biological conditions still exist at this point.

Station #8 - Jackson River at the last bridge, crossing downstream from Iron Gate, Virginia.

The water was tea colored and still showed signs of foam. Approximately ten dead fish, primarily suckers and minnows were noted in the area. The rocks were still black and slime was still

present. The bottom organisms consisted of ten kinds (genera), including pollution-tolerant and intermediate forms. The square good sample contained 464 bottom organisms which consisted of 176 sludgeworms, 208 air-breathing snails (2 genera), 8 leeches, and 72 intermediate midge larvae (3 genera). Degraded biological conditions are still indicated at this station although there is some improvement. The VMI survey also indicated some improvement.

Station #9 - The Cowpasture River at the Virginia Route 633 Bridge.

This stream was extremely clear, and numerous smallmouth bass were observed through the area. The surrounding area is farming country and appears to be primarily pasture land. Twenty-two kinds (genera) of bottom organisms were found which included such clean water forms as stoneflies (2 genera), mayflies (3 genera), caddisflies (3 genera) and riffle beetles (2 genera). There was a total of 440 bottom organisms in the square foot sample. It included 26 stoneflies, 32 mayflies, 230 caddisflies, and 80 riffle beetles. Based on the great diversification of bottom organisms and the high percentage of clean-water forms, the Cowpasture River contributes high quality water to the Jackson River to form the James River downstream from this station.

2. James River

Station #1 - James River approximately 100 yards downstream from the first dam downstream from the Maury River near Glasgow, Virginia.

The water at this station was very clear and numerous fish were observed throughout the area. Most of these fish were minnows.

Good water quality was indicated by the 16 kinds (genera) of bottom organisms collected which included such clean-water forms as caddisflies (4 genera), gill-breathing snails (3 genera) and riffle beetles. Out of a total of 2,025 bottom organisms in the square foot sample, there were 536 caddisflies and 64 riffle beetles. Good water quality was indicated at this location.

Station #2 - James River approximately 50 yards upstream from Battery Creek (West Bank) which is upstream from Big Island, Virginia.

Numerous minnows were observed at this station. The water appeared to be a light tea color but was clear in the bottle. Sampling had to be confined to about four to five feet off the bank because of the sharp drop-off, and a quantitative sample was not taken for this reason. Nine kinds (genera) of bottom organisms were found which included one kind of gill-breathing snail, two kinds of air-breathing snails, flatworms, leeches, and four kinds of intermediate midge larvae. Fair to good water quality was indicated; however, it is believed that a much greater diversification could have been found if a riffle area had been present. Based on this limited biological sampling, unpolluted biological conditions were indicated at this station.

Station #3 - James River immediately upstream from Skimmer Creek and downstream from Big Island, Virginia.

The water was a dark, tea color and fish could not be observed. Due to a very sharp drop-off, bottom sampling had to be confined to the immediate bank. Bottom organisms could not be found in this

area. While there appears to be mild degradation, it was difficult to make a judgement based on bottom organisms because of poor sampling conditions and the lack of a riffle area.

Station #4 - James River upstream from the low level dam at Coleman Falls, Virginia.

The water continued to be tea color but was clear in the bottle. The bottom in this area appeared to be coated with a black, gelatinous material and bottom organisms were sparse. Only a few bloodworms and bristleworm (Nais sp.) could be found. Again, sampling had to be confined to the bank area due to the sharp drop-off. Because of the drop-off and the sparse bottom organism population, a quantitative sample was not taken. A few minnows were observed in the sample area. Based on the bottom organisms and known dissolved oxygen readings, mild degradation is still indicated at this station.

Station #5 - James River approximately 150 yards downstream from the low level dam at Coleman Falls, Virginia.

The water still appeared tea color but was clear in the bottle. Only six kinds (genera) of bottom organisms were present and they were sparse. They consisted of a gill-breathing snail, an air-breathing snail, flatworms, a bristleworm, a dragonfly nymph, and a few intermediate midge larvae. Sampling still had to be confined to the banks because of the sharp drop-off. A quantitative sample was not taken because of the poor sampling conditions and sparse population. Based on the known water chemistry at this station, recovery appears to have occurred

despite the low number of bottom organisms. It is believed the low number of bottom organisms sampled can be attributed to the poor sampling conditions created by the impoundments in this area.

Station #6 - James River at Holcomb Rock upstream from Lynchburg, Virginia.

The water continued tea color but again was clear in the bottle. Bottom organisms were sparse and only a few sludgeworms and gill-breathing snails could be found. Due to a sharp drop-off and impoundment conditions, sampling had to be confined to the banks. The water chemistry at this station indicates that recovery has occurred at this station. The poor bottom organism population is attributed to poor sampling conditions and poor habitat created by impounded conditions.

Station #7 - James River downstream from a low level dam downstream from Daniel Island, opposite Lynchburg, Virginia (East Bank).

The water was dark, tea color but was clear in the bottle. Foam had built up in sections below the dam similar to detergent suds. A fisherman was observed in the area and a dead channel catfish approximately 8 inches long was found. Only a qualitative sample was taken due to the drop-off and large rocks. Eight kinds of bottom organisms were sampled which included two kinds of gill breathing snails, two kinds of air-breathing snails, fingernail clams, flatworms, the scud Gammarus sp., and an intermediate midge larvae. Mild degradation would appear to be present at this station.

Station #8 - James River at Six Mile, downstream from Lynchburg, Virginia.

The water at this location was very turbid, and clumps of dead algae were observed floating. Sludge deposits were heavy along the shore and prevented wading out very far from the bank. The only bottom organisms found were sludgeworms and mosquito larvae, both of which are pollution-tolerant. Sludgeworms were abundant. Moderate to heavy degradation was indicated at this location based on the bottom organisms and known dissolved oxygen readings.

Station #9 - James River at Galts Mills

The water at this location was tea color but was clear in the bottle. A total of 15 genera (kinds) of bottom organisms were found at this station which included one kind of mayfly and one kind of gill-breathing snail. Other kinds (genera) sampled included such intermediate forms as fingernail clams, the scud Gammarus sp., two kinds of damselflies, and one kind of dragonfly. Pollution-tolerant organisms included sludgeworms, mosquitoes, two kinds of air-breathing snails, and two kinds of leeches. A qualtitative sample was not taken because the bottom was predominately bedrock. The river appears to be recovering at this station, but recovery had not yet occurred. Mild pollution was still indicated.

Station #10 - James River at Stapleton, Virginia.

The tea color was still present, but the water was clear in the bottle. There was a recent moderate to heavy fish-kill

of white suckers in the area with the majority of them averaging one pound in weight. A large school of white suckers had sought refuge in Partridge Creek and refused to leave the creek and venture out into the James River despite our disturbing them in the mouth of the creek. A total of ten kinds (genera) of bottom organisms were sampled at this station which consisted of two kinds of gill-breathing snails, two kinds of air-breathing snails, fingernail clams, two kinds of leeches, flatworms, and two kinds of intermediate midge larvae. A quantitative sample was not taken because the riffle area was made up of large bedrock. Mild pollution was still indicated.

Station #11 - James River immediately upstream from Christian Mill Creek.

The water at this location still had a tea color but was clear in the bottle, indicating the color was caused by the substrate. Aquatic vegetation was heavy and included duckweed, filamentous algae, moss, and submerged aquatic vegetation. Twelve kinds of bottom organisms were found versus ten upstream. They included such clean-water forms as two kinds of caddisfly larvae and two kinds of gill-breathing snails. It also included one kind of air-breathing snail, fingernail clams, flatworms, sludgeworms, damselflies, another bristleworm and two kinds of intermediate midge larvae. Out of 1,128 bottom organisms in the square foot sample, there were 776 flatworms, 184 caddisflies, 128 intermediate midge larvae, 24 sludgeworms, eight bristleworms, and eight gill-breathing snails. Fair water quality was indicated at this station.

Station #12 - James River at Riverville, Virginia.

The water still appeared tea color but was clear in the bottle. The bottom organism population at this station took a great upsurge in diversification. Twenty-three kinds (genera) were found versus twelve at the upstream station. It included such clean-water bottom organisms as caddisflies (4 kinds), mayflies, riffle beetles (2 kinds), and two kinds of gill-breathing snails. Out of 706 bottom organisms in the square foot sample, there were 280 caddisflies, 232 flatworms, 152 intermediate larvae, 24 riffle beetles, nine air-breathing snails, and one unidentified bristleworm. The river appears to have recovered at this point and good water quality was indicated.

Station #13 - James River at Allen Creek upstream from Bent Creek, Virginia.

The water was still tea color but clear in the bottle. The surrounding land is in farmland and siltation appears heavy. The drop-off was sharp beyond the silted area, and sampling conditions for bottom organisms were extremely poor. Only three kinds (genera) of bottom organisms were found. A quantitative sample was not taken because sampling had to be confined close to the banks because of the soft banks and drop-off. The only clean-water form found was a gill-breathing snail. In addition, an air-breathing snail and one kind of damselfly were found. The poor bottom organism population was attributed to the heavy siltation, absence of a riffle area, and generally poor sampling habitat. Based on the known dissolved oxygen readings and other water chemistry at this station, good water quality still exists at this location.

3. Tye River and Tributaries

Station #1 - Tye River at the Virginia County Road 665 Bridge near Tye River, Virginia.

This station was located upstream from the confluence with the Piney River. The water was clear and a large minnow population was observed. Darters, a member of the perch family, were sampled in the qualitative and quantitative sample. These fish are generally associated with high quality water.

High water quality was indicated both by the number of kinds (genera) and the high percentage of clean-water bottom organisms which were found at this station. The 15 kinds found included such clean-water forms as mayflies (5 genera), caddisflies (2 genera), stoneflies, a gill-breathing snail, and hellgrammites. A total of 121 bottom organisms was taken in the square foot sample which included 72 caddisflies, 35 mayflies, and one hellgrammite.

Station #2 - Piney River approximately 80 yards upstream from Virginia Route 151 Bridge at Piney River, Virginia.

The water at this station was extremely clear and minnows were abundant throughout the area. A hognose sucker about 12 inches long was observed and captured while sampling. The riffle area was extremely large and moss was abundant on the rocks. A total of nine different kinds (genera) of bottom organisms was found which included such clean-water forms as mayflies (4 genera) and caddisflies (2 genera). Two intermediate forms and an organic pollution-tolerant form were also sampled. However, the bottom organism populations were low and only four bottom organisms were collected in the square

foot sample. Based on the qualitative sampling, fair populations of mayflies and caddisflies were present. Good water quality was indicated at this station.

Station #3 - Piney River at Virginia County Road 674 downstream from the American Cyanamid Company at Piney River, Virginia.

The water color at this station had changed to a bluish-green, and the underside of the rocks was covered with an orange precipitate about one-fourth inch thick. Bottom organisms could not be found at this location. It appears that this water degradation is the result of the American Cyanamid Company's operation upstream at Piney River, Virginia.

Station #4 - Tye River at U. S. Route 29 Bridge downstream from the confluence with the Piney River.

The water was clear and all of the rocks were covered with an orange precipitate. Bottom organisms could not be found. Degraded biological conditions are the result of polluted water from the Piney River.

Station #5 - Tye River at Virginia County Road 739 downstream from Tye River, Virginia.

The water was clear and all of the rocks were covered with an orange precipitate. Bottom organisms were absent. Poor water quality is attributed to the Piney River.

Station #6 - Tye River at the Virginia County Road 654 upstream from the Buffalo River confluence.

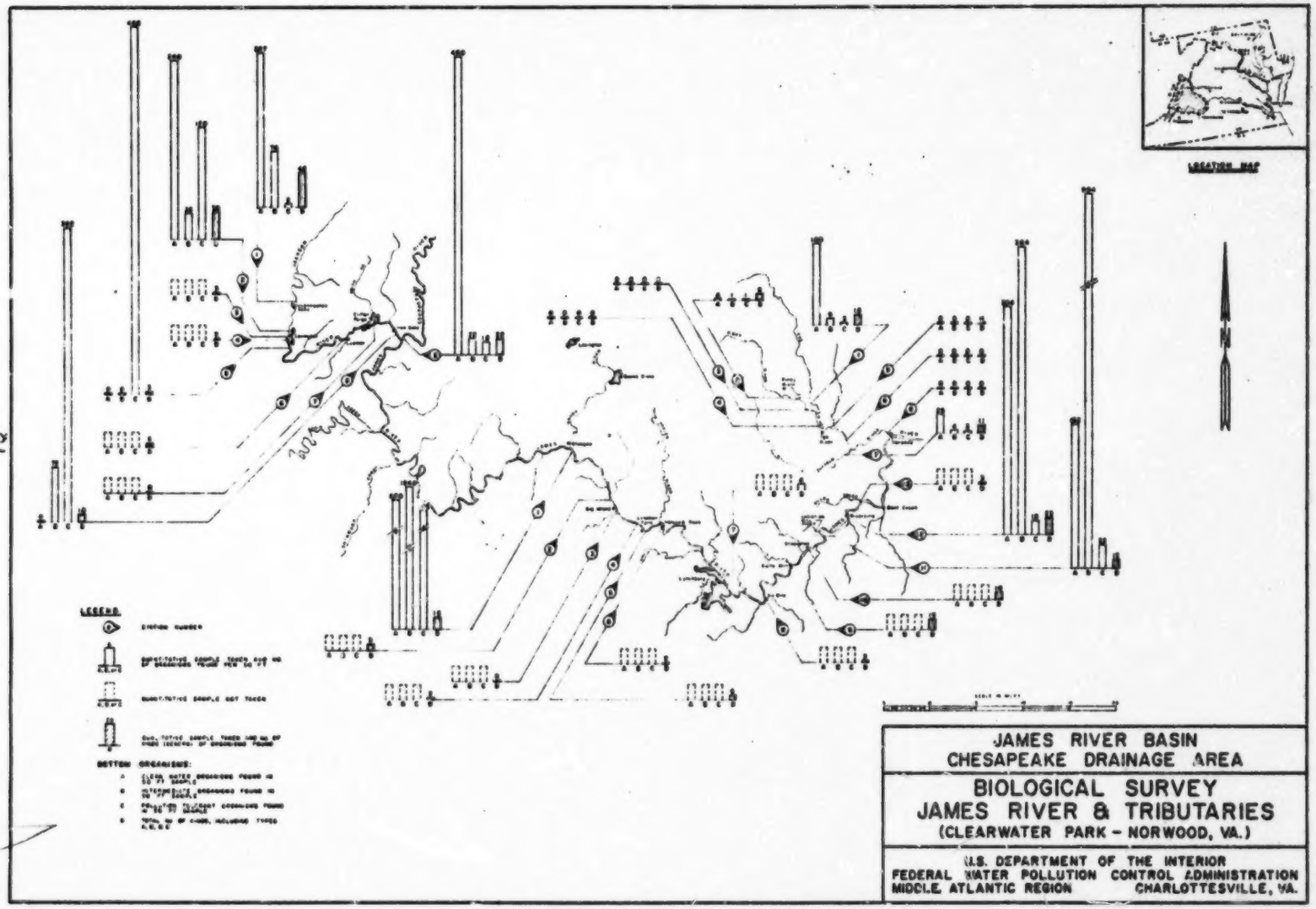
The water was clear and rocks were covered with an orange precipitate. Bottom organisms were still absent. Degraded water quality was still indicated.

Station #7 - Buffalo River at the Virginia County Road 657 Bridge upstream from its confluence with the Tye River.

The water was slightly cloudy from recent rains in the watershed; however, excellent water quality was indicated by the 11 kinds (genera) of bottom organisms which included such clean-water forms as stoneflies (2 genera), mayflies (3 genera) and caddisflies (2 genera). Only 32 bottom organisms were collected in the square foot sample; however, it included two stoneflies, 16 caddisflies, and seven mayflies. The qualitative sample indicated an excellent stonefly population and good mayfly and caddisfly population. If lower water conditions had prevailed, it is believed the quantitative sample would have been much more productive. High water quality was indicated.

Station #8 - Tye River near the mouth at the Virginia County Road 626 at Norwood, Virginia.

The water remained clear and the orange precipitate still was present on the rocks. Bottom organisms could not be found. Degraded biological conditions which were produced by the water from the Piney River are still evident. Poor water quality was contributed to the James River by the Tye River, and apparently James River water quality is adversely affected. How far downstream this affected the James River is difficult to say since water conditions were too high for biological sampling in the James River. However, the rocks were still covered with the orange precipitate at the first bridge crossing on the James River downstream from the confluence with the Tye River.


LOCATION MAP
JAMES RIVER BASIN
CHESAPEAKE DRAINAGE AREA
BIOLOGICAL SURVEY
JAMES RIVER & TRIBUTARIES
(CLEARWATER PARK - NORWOOD, VA.)
U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
MIDDLE ATLANTIC REGION
CHARLOTTESVILLE, VA.